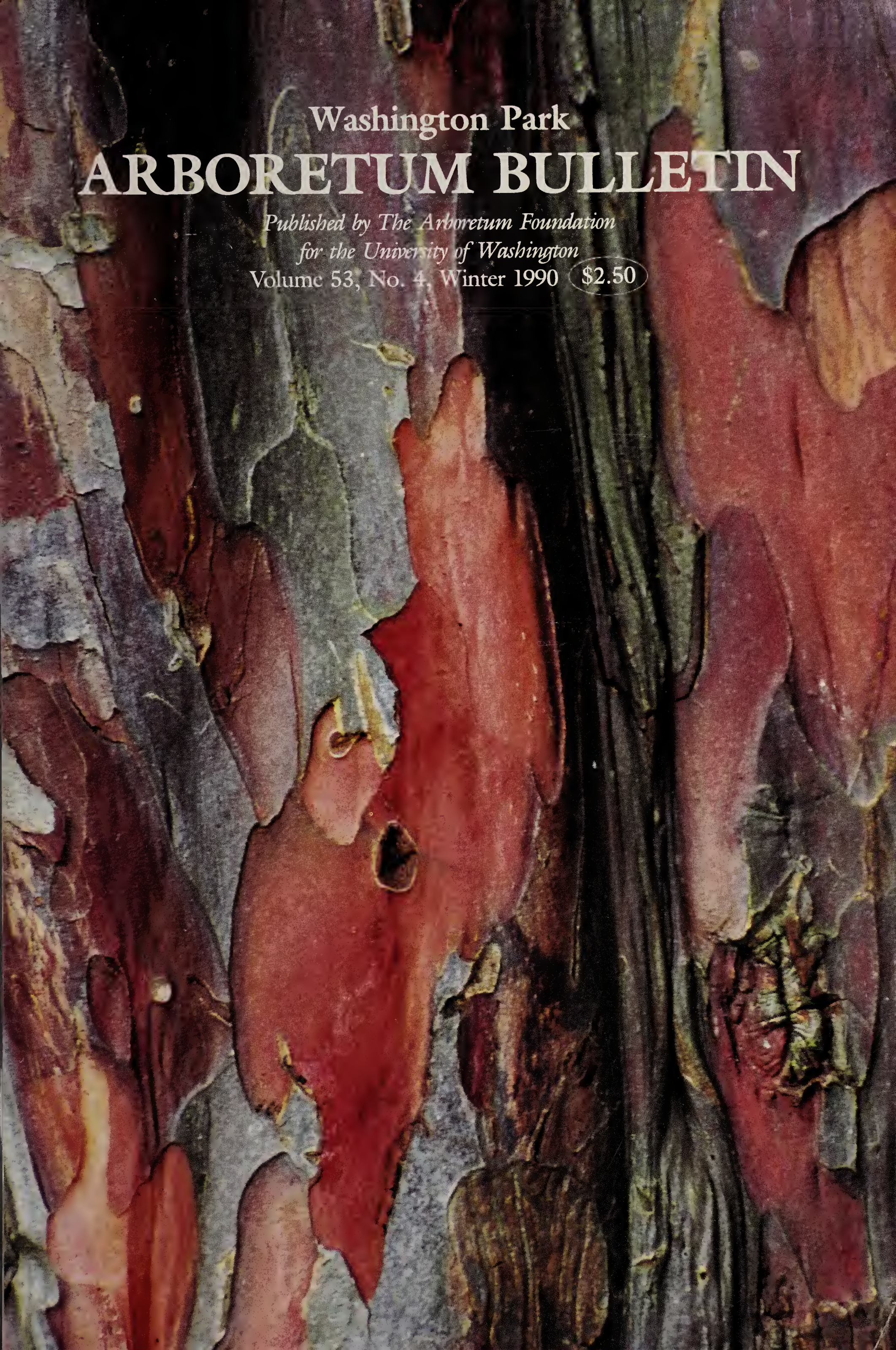

Washington Park

ARBORETUM BULLETIN

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Concerning This Issue. . .

The potential loss of important pharmaceutical resources is a familiar incentive given to preserve tropical forests. Such a need applies to the West's ancient forests—now more than ever. We have chosen for this issue's symbol the efforts to make the Pacific yew (*Taxus brevifolia*) a by-product, instead of a casualty, of old-growth clearcutting (see Daniel Hinkley's article). Its bark is the source of taxol, promising for cancer treatment. Although medical and environmental interests frequently are perceived of as having disparate needs, they have joined together in this case to preserve northwest North America's native yew. Witness the mutual effort of the American Cancer Society and the Environmental Defense Fund in asking the Interior Department to list it as a threatened species. This effort shows how, together, all sectors of society can meet today's environmental challenges and societal goals.

One of the functions of an arboretum is conservation. Edward O. Guerrant, Jr., explains what Oregon's Berry Botanic Garden is doing to conserve plants in the Pacific Northwest. Washington Park Arboretum Curator Tim Hohn updates us on Arboretum efforts, emphasizing that *conservation* is part of each arboretum's definition.

There are more than 50 ways to save the earth and a recent book with a like title gives us a jump start. There also are many horticultural ways to save the Northwest. The Center for Urban Horticulture's David Stockdale starts us off with thirty-something of them.

What else to do? With anticipated summer climate warming, the drought-tolerant garden generates much interest. Howard Stenn reveals how Seattle's Good Shepherd Center developed an attractive and functional border using the precepts of low watering.

The golden chinquapin is a native broad-leaved evergreen of Washington. Although excellent for home gardens, it is losing ground in its home state, as Arthur Kruckeberg points out in his article. Conversely, the Bloedel Reserve's cultivated golden chinquapins are thriving; Richard Brown explains how this is accomplished.

Integrated Pest Management has come into its own in Northwest gardens, as Van M. Bobbitt examines in his column. Then Chris Pfeiffer and Timothy Hohn update us on this fall's Arboretum.

Book Review Editor Valerie Easton recognizes the importance of the theme of "water" and gives further information. Virginia Morell reviews the *Vanishing Garden*, and Kern Ewing discusses the *Ecology of Urban Habitats*.

The year of Earth Day 1990 has drawn to a close. The *Arboretum Bulletin* takes this as a renewed starting point to examine the place in the environmental community for the Washington Park Arboretum.

Jan Silver, Editor
The Washington Park Arboretum Bulletin

*Cover: Bark of Pacific yew (*Taxus brevifolia*), which may be designated as "threatened" by the Department of the Interior. The by-product of yew bark (taxol) is used to make a drug for cancer treatment. Photo by Michael Jardeen, Ronin Photography, courtesy of* Sunset Magazine.

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Background photo: The Arboretum's *Franklinia alatamaha*, extinct in the wild (see page 8). Photo by William Eng, courtesy Center for Urban Horticulture.

The Washington Park Arboretum Bulletin is published quarterly, as a bonus of membership in The Arboretum Foundation. The Arboretum Foundation is a non-profit organization that was chartered to further the development of the Washington Park Arboretum, its projects and programs, by means of volunteer service and fund-raising projects. The Washington Park Arboretum is administered through cooperative efforts between the University of Washington, the Center for Urban Horticulture, and the City of Seattle Department of Parks and Recreation. The programs and plant collections are a responsibility of the Center for Urban Horticulture.

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Thinking of Yew

by Daniel Hinkley

Though incredible advances have been made in synthesizing new drugs, it is the compounds extracted from living plants that comprise nearly half of those used in modern human medicine (Wilkins 1988). The most efficient and complex chemical manufacturing takes place not in the biochemist's laboratory, but in the plant cell. Pharmacognosy is far from a young science—indeed it is an ancient study spanning the width of all cultures. Yet the surface has only been scratched in exploring molecular inventories of the plant kingdom on Earth.

During a major plant screening program instituted by the National Cancer Institute (NCI) in the 1960s, hundreds of individual plant species were tested for compounds that showed a positive effect on slowing or stopping the growth of cancer cells. A crude extract of a yew native to the west coast of the United States was the most promising material retrieved, showing strong activity against a mouse leukemia. At last, *Taxus brevifolia*, known commonly as the Pacific yew, would receive due attention after more than a century of indifference from the current human tenants of its native range.

Such was not the case before the arrival of the European settlers. The yew, native from southeast Alaska to northern California (San Francisco), and east to northern Montana, was valued by the Northwest Indian tribes for its strong durable wood which they fashioned into harpoons, bows, and canoe paddles. The Native Americans utilized the strength of the wood to make wedges for splitting logs and clubs used in battle and hunting (Arno 1977).

Taxus brevifolia is not an abundant species, although in parts of its range it may be considered common. In areas of its greatest concentration, southern Oregon and northern California, a per-acre average of 10 trees is not unusual, whereas one to three trees per acre would be more likely encountered in the Puget Sound basin (Hadley 1987). This species, found growing in dense shade provided by mature stands of Douglas-fir and hemlock, is most easily identified by its yellowish-green foliage arranged in two ranks down the stem. The young stems, unlike those of other conifers in the area, remain green for a full year. In foliage, *Taxus brevifolia* easily can be confused with the coastal redwood, *Sequoia sempervirens*. When an individual needle is pulled from the stem, the leaf of a yew will break clean, whereas in the redwood a portion of the stem will be torn away. The fruit, produced on branches of the female trees, is a red fleshy berry, referred to as an *aril*. Abundant specimens can be seen in Seattle's Seward Park and Ravenna Park. The Matthews Beach children's playground has two specimens nearby. Lincoln Park in West Seattle boasts two very old trees.

The Cascade Crest delineates two distinct variants of the Pacific yew. The west slope type, both rigid and sparse, has been largely ignored by horticulturists for justifiable reasons. Ornamentally, it possesses few qualities to encourage its use in our landscapes other than its tolerance of dense shade. On the drier eastern slope, it grows as a spreading shrub and the foliage takes on a cool blue-green (A. Kruckeberg 1982). Mareen Kruckeberg, of MSK Nursery, Seattle, has long grown the eastern variant and finds it both remarkable in beauty and popular with her clientele.

Though it was not spared the axe when foresters were cutting or thinning commercial stands of timber, *Taxus brevifolia* was never considered economically feasible to harvest. Scarcely noticed by the logging industry, these incredibly slow-growing and long-lived trees were worth nothing more than fuel for the slash pile. Things have changed.

The crude extract of the bark tested in the late 1960s yielded a substance identified in 1971 as taxol. Found in extremely small quantities throughout the plant, taxol has been proven to be very effective on slow-growing solid tumors characteristic of lung, uterine, colon, pancreas, and prostate cancers. The initial results from preliminary trials have excited cancer researchers throughout the world. According to NCI, a 30% partial or complete remission has been reported in treated patients with advanced ovarian cancer. The even more effective route of cancer treatment, that of combining two or more drugs, has not yet begun due to insufficient quantities available to researchers.

It takes 20,000 pounds of air-dried yew bark to make one kilogram (2.2046 pounds) of taxol; each

Glossary

Aril is the fruit type generally found in the yew family, Taxaceae, consisting of fleshy fruit surrounding, but not entirely enclosing, a single seed.

Pharmacognosy is the science dealing with the composition, production, use, and history of drugs derived from plants and animals.

Michael Jardeen
Courtesy of Sunset Magazine

Pacific yew

mature yew may yield 5 to 15 pounds of bark. The National Cancer Institute began clinical trials of taxol in 1989 after receiving 60,000 pounds of Pacific yew bark in 1987-1988 (Hadley 1987). An additional 60,000 pounds was supplied from Northwest forests in 1988-89. In 1990, further orders for bark totaling 500,000 pounds were received by Hauser Chemical Research, Inc., of Boulder, Colorado—a chemical and engineering technology company now providing bark to the NCI. This represents a three-year harvest of perhaps 62,000 mature specimens. The trees harvested from 1987 to 1989 have supplied enough taxol for clinical studies involving 20 groups of 10 to 30 patients per year, according to Dr. Gordon Cragg, chemist at the Natural Products Branch of NCI (quoted in Hadley 1987). The newly discovered interest in this tree has not come without a price.

It takes little thought to comprehend the impact of a continued harvest of *Taxus brevifolia* at such an accelerated rate. Nor, would most of humankind wish to deny the chance of life for those stricken with cancer. Dr. Cragg seems keenly aware of the burgeoning concern over the harvest of the yew, yet he feels the excitement generated over taxol will not allow a retreat until alternative means are available for its procurement. Cragg sees a very short-term industry in the wild collection of the Pacific yew because frontal assaults in several areas of research soon will be in full swing.

Although laboratory synthesis of taxol has been the major target of organic chemists for over a decade, very little real progress has been made in achieving this goal. However, a taxol precursor known as desacetyl baccatin has been extracted in large quantities from the leaves of *Taxus baccata*, the English yew, which then can be manufactured into taxol using a four-step process.

According to Robert Lease, Office of Sale Preparation, United States Forest Service (Portland, Oregon), a breeding program of *Taxus brevifolia* is on the horizon which he hopes will result in trees with a higher concentration of taxol (personal communication, November 1990). Presently, however, more effort is being spent developing marketing strategies for the cut, de-barked yew logs than on actual deployment of such a program. Lease reports that Weyerhaeuser already has begun field production of trees, which will facilitate harvest as well as alleviate pressure on native stands. If all goes as planned, the yew hedges simply will be heavily pruned each year, rather than wholly sacrificed.

Whatever the direction ultimately taken by taxol manufacturers, it will not be a love for a yew long forgotten, but the inefficient economics of wild collection that ultimately will preserve its numbers. How saddening is the thought that certain plants from around the globe, which have been thoughtlessly and methodically eradicated from existence, might have been potential cures for widespread and malignant human illness. Here, though—in the native range of the Pacific yew—we may revel in the fact that we have an example of the paramount importance in preservation of species.

Daniel Hinkley is an instructor of horticulture at Edmonds Community College. He is a member of The Arboretum Foundation Board and the editorial board of the *Washington Park Arboretum Bulletin*.

Sources of *Taxus brevifolia*:

MSK Nursery, 20066 - 15th Avenue NW, Seattle, WA 98177

Heronswood Nursery, 7530 - 288th NE, Kingston, WA 98346

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Illustrations by Anne Walton

Fritillaria gentneri

Castilleja levisecta

Fritillaria recurva

Plant Conservation in the Pacific Northwest: A Small Garden's View

by Edward O. Guerrant, Jr.

The plight of tropical rain forests, spotted owls, and old-growth forests is well known to the public. But it is not well known that many of Washington's plants face the shadow of extinction with only minimal legal protection. This article attempts to provide an introduction to conservation efforts being marshaled on behalf of our beleaguered Northwest flora. It is written from the perspective of one cog in the conservation-community wheel—the Berry Botanic Garden in Portland, Oregon. Conservation of rare and endangered plants native to the Pacific Northwest is one of the primary missions of the Garden.

At the heart of the conservation program is the Berry Botanic Garden Seed Bank for Rare and Endangered Plants of the Pacific Northwest, founded in 1983. Its first curator, Julie Kierstead, created and ably filled a vital niche in a very active, diverse plant conservation community in the Northwest. The Seed Bank currently houses over 1,000 accessions comprising more than 225 taxa. Each accession represents a single sample with a unique identification number; it contains seeds from an individual population, plant, or flower, depending on the situation.

Included in the Seed Bank are all three species of Oregon plants that are on the federal endangered species list: *Lomatium bradshawii*, *Mirabilis macfarlanei*, and *Stephanomeria malheurensis*. Although Washington State also is home to some deserving species, none have yet been federally listed and there is no Washington State endangered species law to fill the gap. Oregon, however, does have a law and an active interest in protecting rare and endangered plants. In addition to the three federally listed plants, the Seed Bank has samples of the other nine plants on Oregon's list of endangered species: *Abronia umbellata* ssp. *breviflora*, *Astragalus applegatei*, *Calochortus umpquanensis*, *Erigeron decumbens*, *Haplopappus radiatus*, *Lilium occidentale*, *Lomatium cookii*, *Plagiobothrys hirtus*, and *Thelypodium howellii* ssp. *spectabilis*.

The value of such off-site (*ex situ*) storage of dor-

mant seed in the Seed Bank is that a genetically representative seed sample can be protected against catastrophic habitat loss or other calamity. What constitutes an adequate sample and how much is too much to collect from a population at any one time without hurting its chances of survival are complex questions that must be faced continually. A political danger in having *ex situ* collections is the mistaken belief that seed storage is a suitable end in itself. However, merely banking seeds of a threatened population—for example, to "mitigate" land development—is not adequate conservation. Once we decide to work with a species, seeds are gathered, cleaned, dried, and stored at sub-freezing temperatures in airtight containers. Of course, even under these conditions, seed life is not indefinite. Periodic checks of viability must be made and stocks that show low percentages of germination must be replaced.

The Berry Botanic Garden plays a vital role, but our work is neither a complete conservation effort nor does it operate in a vacuum. Rare and endangered plants have advocates in a variety of both federal and state agencies, and there are many private organizations—each with its own agenda. All, however, are united by the common goal of saving our natural heritage from being lost forever.

The most potent federal power marshaled in defense of plants in peril is the Federal Endangered Species Act of 1973. The United States Fish and Wildlife Service (USFWS) is charged with determining the species which should be listed and, just as important, which do not deserve such protection. However, even without political impediments (recall the spotted owl's first run through the bureaucracy), at the rate they are going with current staffing and funding levels it will take over a century for the USFWS to evaluate candidate species now under consideration for listing as either threatened or endangered (according to calculations by Eric Wold, conservation intern at the Berry). Clearly, this is not sufficient protection of our rare plants in this rapidly changing world.

In deciding which species with which to work, however, the federal list of threatened and endangered species, and the Federal Register of candidate species for listing are a good place to begin. They are comprehensive, though blunt, instruments.

Whenever we at the Garden begin to work with a taxon, the first place we go for specific information about particular populations is the Nature Conservancy's Natural Heritage Programs, established in each of the 50 states. The data base in each state is the most comprehensive body of information about rare taxa that exists—an ongoing record of size and threats to each and every known population for all taxa of concern. In Oregon, the Nature Conservancy still maintains the Natural Heritage Data Base, but in Washington, the State has assumed that responsibility. The Heritage Programs serve as an information center. Those who work with rare plants provide information to the program. The value of a central repository for the site-specific information should be emphasized.

Much of the Garden's work with rare plants is done in cooperation with state and federal agencies. For example, we currently are conducting a genetic evaluation of *Fritillaria gentneri*, a very rare fritillary from southern Oregon. There are persistent suggestions that the species might be a sporadically occurring hybrid between *F. lanceolata* and *F. recurva*, thus not a 'good' species. Given the taxonomic uncertainty, neither the state nor the federal government may confidently take steps to protect it. However, both the Bureau of Land Management (BLM) and the state of Oregon are interested in resolving the issue. Both of them are working with the Garden on a cost-share basis to conduct a comparative electrophoretic analysis of these three taxa to determine the evolutionary status of *F. gentneri*.

We also work closely with the United States Forest Service (USFS) in its attempts to protect our common heritage. The USFS has in recent years been hiring botanists for each of the forests; their job, in part, is to be advocates, within the system, for rare and endangered plants. Toward this end, the Garden has participated in cost-share projects with different forests to bank seed of sensitive plants in their areas.

Although governmental bureaucracies have the reputation of aspiring to be autonomous empires, this is not the case with those working with rare plants. For many years, virtually all state and federal

Glossary

Electrophoretic analysis is a laboratory technique that allows researchers to compare genetically based properties of enzymes in individual organisms, so that differences within and between populations may be evaluated. A variety of inferences can be drawn from such data.

Taxon (plural is taxa) is a taxonomic group of any rank (e.g., genus, species, variety, etc.).

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agencies that work with rare and endangered plant species have gathered informally twice a year to share information. This Interagency Endangered Plant Committee exists to coordinate work among interested parties to see that the most critical plants are attended to, and to minimize the duplication of effort. The agencies not only talk to each other, but they actually can work together, too. The Berry Botanic Garden currently is working with the BLM, USFS, and the state of Oregon's Endangered Plant Program to develop a project to ascertain why one of only three known populations of *Erythronium elegans* is losing ground. The ultimate goal of this population study is to acquire knowledge that will allow us jointly to make the world a safer place for this elegant trout lily.

Among the many private organizations working to conserve rare and endangered plants, both Washington and Oregon have native plant societies that have long been interested and active in rare plant conservation. Some of the most detailed information about plants is known by amateurs in these organizations.

Like the Nature Conservancy, the Center for Plant Conservation (CPC) is national in scope. The CPC is a national consortium of botanic gardens and arboreta dedicated to preserving our nation's most vulnerable plants; the Berry Botanic Garden is CPC's participating Northwest institution. To help ensure that resources will be available to curate these seeds in perpetuity, the CPC has established a program to ''sponsor'' plants: For each species so endowed, the interest from a dedicated fund of $10,000 is used exclusively to attend to that species. Currently, three Washington State species are so sponsored—*Castilleja levisecta*, *Howellia aquatilis*, and *Ranunculus reconditus*. Among the sponsors is the USFWS itself—the agency primarily responsible for protecting our natural heritage. The ultimate goal is, of course, not simply to store them in a freezer, but rather to have viable seed available for reintroduction, if necessary.

An exciting new development is the recent emergence of the Rare Plant Consortium, a formal network among those working on rare plants in the Northwest. It is being organized by Dr. Rich Everett of the USFS's Pacific Northwest Forest and Range Experiment Station in Wenatchee, Washington. A major purpose of the Consortium is to be a focus that brings together all those people in government, private agencies, and academia working on rare plants.

There is an active community interested in conserving rare and endangered plant species native to the Pacific Northwest. Although the task of conserving our natural heritage is formidable and getting more so, the cooperation among public and private groups described here shows that even a small institution, such as the six-acre Berry Botanic Garden, can make a difference.

Edward O. Guerrant, Jr., is Conservation Director and Seed Bank Curator for the Berry Botanic Garden.

Private Plant Conservation Organizations

National
The Center for Plant Conservation
125 Arborway
Jamaica Plain, MA 02130
(617) 524-6988

Washington
The Nature Conservancy
1601 Second Avenue, Suite 910
Seattle, WA 98101
(206) 728-9696

Washington Native Plant Society
c/o Dr. Art Kruckeberg
Department of Botany (KB-15)
University of Washington
Seattle, WA 98195
(206) 543-1976

Oregon
The Berry Botanic Garden
11505 SW Summerville Avenue
Portland, OR 97219
(503) 636-4112

The Nature Conservancy
1205 NW 25th
Portland, OR 97210
(503) 228-9561

Native Plant Society of Oregon
c/o Mary Falconer, Membership Chair
1920 Engle Court NW
Salem, OR 97304

Purchasing Endangered Plants

As an individual gardener, you can help conserve rare and endangered species by purchasing rare bulbs and seeds carefully. Sources that are otherwise environmentally sensitive sometimes collect in the wild or receive seed that is wild collected. Warns Berry Botanic Garden's Dr. Ed Guerrant: Ask your dealer if his or her stock is wild collected or nursery propagated.

The Natural Resources Defense Council (NRDC) is working with the World Wildlife Fund, the Garden Club of America, the Fauna and Flora Preservation Society, and others to educate gardeners about bulbs that are of wild origins. Many consider the best source for current information to be NRDC's Faith Campbell.

In an article in the winter 1990 "Berry Botanic Garden Newsletter," Ed Guerrant suggests keeping in mind that many bulbs in mail-order catalogs have been collected directly from the wild. This contributes to the demise of these plants in their native habitats. He cites Dr. Campbell's list of bulbous plants to beware of, including a wide variety of herbaceous perennials having corms, tubers, rhizomes, or other underground storage organs. Dr. Guerrant points out that these plants are most easily collected when they are still green, "before they have set seed, which leaves little chance for impacted populations to replace themselves."

The following dealers have pledged not to sell wild-collected plants: Burpee, Smith and Hawkens (U.S.), van Tubergen (the Netherlands), Hortico (a consortium of the four largest British mail-order companies), and Tesco (another British company). The Dutch bulb industry has adopted a labeling program.—J.S.

NRDC and American Horticultural Society suggest asking about the origin of the following:

Anemone spp. (blue or mixed A. blanda)
Chionodoxa sardensis, *C. tmoli*, *C. luciliae*
Cyclamen species (not the kind normally purchased in stores and nurseries)
Cypripedium species
Eranthis hyemalis and *E. cilicica*
Erythronium species (except for 'Pagoda')
Fritillaria persica and *F. imperialis*
Galanthus (except *G. nivalis*)
Leucojum vernum and *L. aestivum*
Narcissus triandrus var. *albus*, *N. asturiensis*, and *N. cyclamineus*. *Narcissus bulbocodium conspicuus* is propagated, but also wild-collected in Portugal.
Scilla species
Sternbergia
Trillium spp., especially *T. grandiflorium*
Tulipa praecox
Crocus, *Fritillaria*, and *Iris* specialized species

For more information contact:

Thomas M. Barrett, Gardeners' Information Service, American Horticultural Society (AHS), Box 0105, Mount Vernon, Virginia 22121. See also AHS's November 1990 *News Edition*.

Dr. Faith Campbell, Natural Resources Defense Council, 1350 New York Avenue NW, Washington, DC 20005; (202-783-7800)

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Keeping the Cogs: Conservation at the Washington Park Arboretum

by Timothy Hohn

The first word in ignorance is the man who says of an animal or plant: 'What good is it?' If the biota, in the course of aeons, has built something we like but do not understand, then who but a fool would discard seemingly useless parts? To keep every cog and wheel is the first precaution of intelligent tinkering.
—Aldo Leopold

William Eng

Magnolia wilsonii

Conservation is the raison d'être of any museum. It is one of our four primary purposes as defined on the back cover of this *Bulletin*. Focusing our understanding of conservation will make us aware of special areas of need, helps to direct our conservation energies, and encourages us to undertake the preservation of threatened natural areas, communities, and organisms. Living and natural history museums play a vital role in these efforts.

But before delving any further, we should decide exactly what we mean by "conservation." Webster defines it as "protection from loss, waste, etc.; preservation." Preservation recently has become a "buzz word" in our vocabulary although some of its meaning may have "buzzed" off. Turning to Webster again: "to keep from harm, danger, evil, etc.; protect; save." Conservation, at its heart, therefore means to protect and save—in this case, those items pertinent to or within the museum's collection.

To protect and save objects and/or organisms is the founding precept of a museum, whether its collection is composed of Renaissance art, Australian birds, or trees in the genus *Quercus*. Without adequate preservation measures, museum-aspiring institutions could not be entrusted with the stewardship of collections having cultural or scientific value. Art museums would be reduced to the status of wayward antique emporiums; zoological gardens would be no better than the bestial menageries of the nineteenth century; arboreta and botanical gardens would be stripped of their educational and research dimensions, leaving only the simple landscape amenities of parks.

To preserve their collections, museums go to great lengths to modify environments and limit potentially destructive forces. This helps to create relatively idyllic conditions for the collections entrusted to them. To ensure adequate conservation, most museums do not keep their entire collection on public display, but rotate them as educational needs and public interest arise, thereby minimizing the risks of loss and degradation. Living collections can be particularly difficult to preserve. Plants and animals are not always responsive to the best intentions of their caretakers and are subject to the vagaries of an unpredictable environment.

At the Washington Park Arboretum and other botanical gardens and arboreta, our conservation charge is great. To conserve plants and promulgate

Glossary

Sepal is the usually green, outer ring of floral parts.

Stamens are the male reproductive elements of a flower.

Stomata are minute openings for gaseous interchange.

Taxon (plural is taxa) is a taxonomic group of any rank (e.g., genus, species, variety, etc.)

Tepal is an undifferentiated petal or sepal.

a conservation ethic in the minds of those beings most threatening to them is the true test of the starch of which we are made. At the Center for Urban Horticulture/Washington Park Arboretum, we strive to conserve and protect the plant collection with six comprehensive, often overlapping, operations within our curatorial program: acquisition, keeping plant records, propagation, plant distribution, preservation and maintenance, and preservation and security.

Acquisition: Wild-collected natural taxa and well-documented cultivars

We seek to acquire plants from a sampling of wild populations presumed to have some degree of genetic variation. In this way, we can optimize our chances for conserving the greatest degree of biological potential available within a particular plant. For plants of a cultivated origin, it is important that the taxon have a documented pedigree to authenticate its identity, thereby justifying conservation efforts.

Keeping Plant Records: Accurate and thorough records of each individual accession

We expend a great deal of time and effort to establish and maintain accurate source, taxonomic, lineage, cultural, and inventory records of the plant collection. This serves to authenticate the collection, thereby lending educational and research credibility to each documented plant. By doing so, we help to ensure that our preservation efforts are well directed and that each accession contributes to the conservation of the particular species on a regional, national, or international scale.

Propagation: Renewal and maintenance of the plant collection

The plant propagation program, conducted in the Douglas Conservatory at the Center for Urban Horticulture, has a three-part focus: (1) to re-propagate rare, unusual, and single individuals of an accession, such as *Quercus nubium* in the Japanese Garden; (2) to propagate new accessions, such as a plant from another part of its natural range; and (3) to propagate plants for distribution in order to insure larger cultivated populations. The basic conservation effort here is simply the continuance and maintenance of the valuable accessions in our collection, particularly those with a designated conservation status based on their status in the wild.

Plant Distribution: Distribution of a larger pool of plants to other growing sites

We distribute propagules and plantlets to other museums, educational institutions, commercial enterprises, and the public to increase the pool of existing individuals of a particular taxon. In this way, it is possible for gardens, in effect, to expand their collections off site while making interesting and useful plants available to others. The ultimate conservation success in horticulture is the widespread propagation, sale, and landscape use of a genetically diverse selection of plants representing a particular taxon. *Franklinia alatamaha* is a good example, although it could still be more widely grown; unfortunately, the original propagules are thought to have come from a single individual.

Preservation and Maintenance: Adequate horticultural care of the plant collection

Providing adequate horticultural care for each individual in a collection is a major goal of the Arboretum. It is an ambitious goal on approximately 200 acres with 40,000 accessions and only six plant-care staff. We employ a triage approach to meeting immediate collection needs based on continuous monitoring, organized scheduling, and mechanization. Still, at times the operation runs like a series of fire drills and many portions of the collection are inadvertently unattended. Some of the long-term goals to improve our efforts revolve around acquiring preservation and plant-care funds with all new display and display renovation projects. Contributions to the University of Washington's ArborFund for the care of trees in the Arboretum will help us improve our tree preservation efforts.

Preservation and Security: Protection against damage and theft

Protecting the plant collection on display against damage or theft by visitors is one of our *most daunting* conservation problems. Uncontrolled access, carelessness, and inappropriate activities by visitors subject the plant collection to all types of damage. Theft by penny-pinching gardeners and unscrupulous collectors adds to this problem. In addition to theft, our most serious problems stem from inappropriate recreational activities such as mountain bikes, unleashed dogs (those running loose with their leash are particularly damaging), and mindless, primarily nocturnal, vandalism. These conditions set back and often nullify the conservation benefits accruing from our other programs, resulting in a serious waste of time, effort, and money. It is partly this concern that makes it implicit that zoological gardens, for example, be well secured and operated under conditions of controlled access and strict behavioral codes. Yet, this orientation is hard to instill regarding the Arboretum.

The Center for Urban Horticulture and Washington Park Arboretum also seek to facilitate a public understanding of conservation. This is done not only for continued support of the institution, its mission, and the maintenance of the plant collection itself, but to achieve the broader, long-range goal of advocacy for the preservation of natural habitats. Many of the educational and interpretive programs at the Washington Park Arboretum focus on conservation issues and often are infused with related messages. The Saplings Program for elementary school children is a perfect example. Children from local schools come to the Arboretum and learn about native plants, the concept of habitat, and conservation biology (see *The Washington Park Arboretum Bulletin* 51(3): 2-3, "The Saplings Program."). In the future, many of the new interpretive materials and signs at the Arboretum will carry conservation-oriented information.

As a way of expanding our programs and extending our conservation efforts with limited resources, the Center for Urban Horticulture/Washington Park Arboretum is a supporting institutional member of the International Union for the Conservation of Nature and Natural Resources (I.U.C.N.) and the Botanic Gardens Conservation Secretariat. Through this membership, we participate in an international effort to conserve plants and their natural habitats, in addition to cooperating in an international network of botanical gardens and arboreta that shares conservation data on member collections. At present, our collection contains nearly 100 taxa considered rare, vulnerable, endangered, or extinct by the I.U.C.N. Each taxon was acquired by the Arboretum to complete a taxonomic, geographic, or landscape collection focus and display theme. However, given the I.U.C.N. conservation status, they are considered part of a conservation collection as well; therefore, we give them priority consideration in our conservation programs.

To practice conservation, the most important function of the Washington Park Arboretum is to provide effective protective custody over the plant collection. Because our collection is subject to various damaging abuses and thefts, we cannot make the acquisition, display, and preservation of I.U.C.N.-listed taxa a conservation priority, as is done at other arboreta and botanical gardens. Such taxa usually are acquired for other collection goals. Hence, we only can play a very limited role in the *ex situ* conservation of endangered plants—the preservation of organisms outside their natural habitat.

To reiterate an important point, a very useful form of conservation undertaken in the field of horticulture is to successfully introduce conservation taxa with ornamental attributes into cultivation. With this in mind, here are a few (perhaps unfamiliar) ornamental plants from our conservation collection that you might be moved to champion in your own garden. The four plants are considered endangered in their natural habitats by the I.U.C.N. *Endangered* means that they are close to extinction and their survival is unlikely if causal factors, e.g., habitat destruction, harvest, etc., continue.

Abies nebrodensis (Sicilian fir)

Arboretum accession 369-54 from the Arboretum des Barres, Loiret, France

There are so few wild or cultivated specimens of this beautiful fir that accurate descriptions are hard to find. As of 1988, there were only 23 individuals of this species surviving on the slopes of Monte Sealone in northern Sicily (Osti 1988). Deforestation and overgrazing have reduced a once more extensive population to these few trees.

Rather small in stature for a fir, *Abies nebrodensis* is said to rarely exceed 45′ in height, although our 36-year-old trees have reached that now and show no signs of slowing down. Like so many true firs, the Sicilian fir is very stately and symmetrical with the appearance of having been assembled from precisely machined parts. The glossy needles are short and uniformly blunt, almost stocky; on their undersides are two white rows of stomata. The needles are whorled on the upper sides of symmetrical branches that sweep out from the trunk in inverted arches. The branchlets reach out from their points of origin in an unyielding, horizontal, or slightly ascending array. Large specimens of this extremely rare fir can be seen at the south end of the Arboretum directly across the trail from the sign for the spindle tree (*Euonymus*) collection.

Cupressus gigantea (literally means "giant cypress")

Arboretum accession 279-48 from the Missouri Botanical Garden

As further evidence of the undiscovered horticultural treasures of the Far East, *Cupressus gigantea* was described only recently (1975) and was first discovered on the Tsangpo River of southeast Tibet only in 1947. To make a long story short, the Washington Park Arboretum obtained the original seed of this field collection #13345 under the name *C. fallax*; all other cultivated

specimens are derived from our plants.

This cypress is the brute of the genus, towering over its peers at 145′ in the wild. However, our brutes are slow growing and may remain rather humbled in cultivation. Our tallest tree is only about 18′ high and all of them have a distinctly upright habit, forming blue-gray columns of foliage no more than 24″ in diameter on very short, exposed trunks. *Cupressus gigantea* certainly would lend interesting color and verticality to a landscape—individual specimens stand out as blue exclamation points. Two plants can be seen among the collections in Conifer Meadow—one not far from the edge of Lake Washington Boulevard East across from the entrance to S.R. 520, and the other along 26th Avenue, about mid-block. For more information see J.A. Witt's article in volume 45, number 2 of the *Arboretum Bulletin*.

Magnolia wilsonii (Wilson's magnolia)
Arboretum accession 902-47/522-57 from Mrs. Else Frye

It is ironic to find this magnolia, one of the shrubby species with pendent blossoms, listed as endangered (by I.U.C.N. standards). In 1904, Plant Explorer E.H. Wilson described it as being "quite a common shrub in the woods of Western Szechwan. . . ." Its natural distribution also includes eastern Kansu and northern Yunnan provinces, where it probably is disappearing because of deforestation. We are fortunate to have one of the most outstanding specimens of this distinctive magnolia anywhere in cultivation. The flowers, like that of its cousins *M. sieboldii* and *M. sinensis*, are nodding (for the benefit of admiring gardeners below!) and are the largest of the group. The nine tepals form a pearly white arena for the showy red stamens on center stage, the show running throughout May (check) and sporadically in late summer, depending on the weather. Our oldest tree, a vase-shaped, shrubby specimen, is located on the west side of Arboretum Drive East at the entrance to Loderi Valley just north of the columnar tulip trees; it is nearly fully grown and vigorous, in the shade of taller trees in a well-watered location.

Torreya taxifolia (stinking cedar)
Arboretum acquisition 314-81 from the National Arboretum and Callaway Gardens, Pine Mountain, Georgia

Perhaps the rarest conifer in North America, *Torreya taxifolia*, is found in parts of only three counties along the Apalachicola River in the panhandle of Florida. Within this small population, trees up to 40′ once were found, but the effects of a wilt disease have decimated the population. Now, tree-sized specimens exist only in cultivation. The largest is a 60′ tall, 52′-wide monster in a private garden in North Carolina; its trunk is 9′ in circumference. Closely related to the genera *Taxus* and *Cephalotaxus*, the common name refers to the very aromatic needles, unpleasant when crushed, that most closely resemble those of *Cephalotaxus* in size and texture. Young plants, in particular, make handsome ornamentals at the back of the perennial border and as hedges or screens, filling the role of a yew in the landscape. Curiously, a variegated cultivar of this endangered conifer exists with the name 'Argentea', although it, like the species, is rare in the trade.

I have included an account of *Torreya taxifolia* here most especially because it is native to the United States. It is of utmost importance that people seek to assist in the conservation of their native floras. There are many other members of the conservation collection, some extinct in the wild, endangered, vulnerable, or simply rare, with highly ornamental attributes. Look for future articles on these noteworthy plants in the Arboretum collection.

In describing the conservation programs at the Washington Park Arboretum, I have simply scratched the surface of our potential role in plant conservation, and that of botanical gardens and arboreta in general. Suffice it to say, there is no substitute for conservation as the number one concern of all museums. Museum collections provide us with clues and reference points, leading to a better understanding of ourselves and our world—the rudiments of an effective stewardship of the untamed Earth.

Limited numbers of plants described above can be propagated by the Pat Calvert Greenhouse for members of The Arboretum Foundation.

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The Plant Prescription

by David Stockdale

Thirty-something horticultural ways to help save the Northwest are offered below.

Earth Day's twentieth anniversary. Global ReLeaf. The "Environmental" President. Environmental concerns and issues still are making headlines—and rightfully so. Ecologically sound perspectives and practices are necessary to ensure survival in our world.

As home horticulturists, we are directly involved in many planning and management practices that impact the Northwest's environment. The aesthetic and functional benefits of our landscapes are derived from integrating planning and design skills, planting procedures, pest management practices, water management, fertility management, and maintenance and pruning practices.

A recent book from the EarthWorks Group entitled *50 Simple Things You Can Do to Save the Earth* (Berkeley 1989, 96 pages) recommends a variety of activities we each can do to reduce pollution, conserve natural resources, and improve the earth's quality of life. Many practices will lower air and water pollution, lessen energy demands, conserve dwindling water reserves, or reduce the use of harmful pesticides.

What follows is a list of sound horticultural practices—a sort of Northwest plant prescription with global ramifications. Most of these ideas are not new, but only reminders of what each of us can do in our home landscapes.

1. Remember that nature is not perfect. To expect your home landscape to be unblemished is unrealistic and may require an inefficient use of resources. A few brown spots or chewed leaf margins are acceptable.

2. Monitor pest problems. For example, hot and dry summers are ideal for spider mite development; be aware and start checking for mite build-ups early. Look for the stippling of the leaves or hints of webbing on undersides of leaves. Control is easiest when done early.

3. Know the signs of insects and diseases. Invest in some good identification books. Sound pest management starts with early and correct identification of pest organisms.

4. Keep it clean. Good sanitation reduces, if not eliminates, the likelihood of insect and disease population build-ups. Remove trash, replace or refresh old mulches to reduce pest overwintering places, and immediately prune out and destroy infected plant parts.

5. Rotate garden crops. It is possible to lessen pest population booms if seasonal food and ornamental crops are rotated. Base rotations on plant families; for example, re-plant corn (Gramineae) where beans (Leguminosae) grew last season.

6. Use resistant varieties. Although pest resistance in plants does not always ensure complete protection, such plants are far less likely to be affected. Hundreds of choices currently are available. For example, select VFN-designated tomatoes (i.e., resistant to verticillium wilt, fusarium wilt, and nematodes) or verticillium-resistant ornamentals such as apple, conifers, and pyracantha.

7. Dig out those weeds. Chemical herbicides can be limited or eliminated. Mow, hoe, or dig out noxious or overly competitive weeds. Ignore others.

8. Hand pick pests. Early morning and late evening are great times to find pests like cutworms, hornworms, snails, or slugs.

9. Employ natural insect pest enemies. Parasitic wasps (*Trichogramma pretiosum*, *T. minutum*, *Aphytis melinus*, and *A. helvolus*) are used to control a number of insect pests, including codling moth larvae and cutworms. Predators such as lady beetles (*Hippodamia convergens*) consume aphids, scale insects, mites, and more. Lacewings (*Chryopa carnea*) eat aphids, mealy bugs, and spider mites. Midges (*Aphidoletes aphidimyza*) and mites (*Phytoseiulus persimilis*, *P. longipes*, *Metaseiulus occidentalis*, and *Amblyseius cucmeris*) also are voracious predators. Microbial agents such as *Bacillus thuringiensis* (several varieties), the disease pathogen *Nosema locustae*, and predatory nematodes can abate a variety of soil-dwelling insects such as grubworms or cutworms.

10. Trick and trap. Lure insect pests into mechanical traps by use of pheromone (sex attractants) or floral lures which can be ordered through a number of mail-order companies. Dozens of host-specific lures are available.

11. Use "road blocks." Physical barriers such as collars or sticky-foot substances can prevent or slow down crawling pests (such as ants) entry or passage.

12. Cultivate a backyard wildlife sanctuary. The beauty of wildlife-attracting plantings increases the

aesthetic and economic values of your property while the resulting increase of birds and other critters will reduce insect populations. ''Some of the smallest, most colorful, and most pleasant-sounding birds have insects as the main ingredient in their diet,'' according to ''Winter Feeding of Wild Birds Around the Home,'' prepared by Stephen Penland, urban biologist at the Department of Wildlife, Mill Creek, Washington.

13. Solarize. Many soil-borne insect, disease, or weed-seed problems can be reduced or eliminated by soil solarization prior to planting. Lay clear plastic over soil and hold in place by sealing at the edges with clumps of soil or rocks. This encourages heat build-up from solar radiation that will serve to ''cook'' or sterilize the soil. Summer is best to ensure sufficient heat build up.

14. Consider landscaping with native plants. Natives are adapted to our cool, rainy winters and arid, relatively cool summers. They will require little, if any, irrigation most years.

15. Group plants by needs. If moisture-loving and drought-tolerant species are to be used, cluster plants together by requirements for more efficient watering. For example, keep drought-tolerant *Mahonia aquifolium* and *Buddleia alternifolia* in a different location from your willows or other water-requiring plants. Water only those group plantings that need it.

16. Add organic matter. Increasing the organic-matter content of your soil will increase its water-holding capabilities considerably. Sufficient organic matter also increases soil nutrient availability, improves the physical condition and friability of the soil, and improves aeration and water permeability. A great source of organic matter is compost—recycled kitchen vegetable matter, leaves, grass clippings, etc. Compost is ''good'' trash. For composting information, call your local county extension; in King County, request pamphlet KC-5 on composting at (206) 296-3986 or call Dial Extension Tapes at (206) 296-DIAL, extension 444. Also call the Master Gardeners, (206) 296-3440; Seattle Tilth and the Seattle Engineering Department's Compost Hotline, (206) 633-0224; King County Composting and Recycling Hotline, (206) 296-4466; or Master Composters, (206) 684-5353.

17. Mulch. Proper mulching can reduce loss of soil moisture by up to 70%. Mulch also helps insulate soil during temperature fluctuations and reduces weed growth.

18. Irrigate efficiently. Apply water only where and when needed to maintain healthy growth. Drip irrigation is most efficient, allowing you to apply water only on root zones. Trickle irrigation systems and soaker hoses are efficient, but do not allow as much selectivity in water placement. Sprinkler systems are more cost effective for large areas and allow for choices of watering patterns, but are less efficient due to greater evaporative loss potentials and influence of wind on water placement. Hose-end sprinklers are even less expensive, but also less efficient. Drip, trickle, and sprinkler irrigation systems can be operated more efficiently with the addition of manual or automatic timers. You also may consider subirrigation systems or more traditional surface irrigation techniques utilizing furrows or basins. Remember that deep, less frequent waterings are more beneficial for most plants than frequent, shallow water applications.

19. Use shading. Lower summer water needs by placing less drought-tolerant plants in the critical afternoon shade of other plants, screens, or structures.

20. Consider intensive planting schemes. Closer spacing of color or food crop plants may reduce overall plant size, but generally increases yield or color impact. Furthermore, such plantings lessen exposed areas that become subject to increased soil moisture evaporation loss (and also lower weeding needs).

21. Use green manure. Cover crops such as clovers, vetch, or buckwheat often are planted to protect otherwise bare winter garden soils from rain and wind erosion. These crops are tilled in to return nutrients such as nitrogen to the soil, and improve soil structure.

22. Use gray water. Recycle water from dishwashers and washing machines, if no-phosphate detergents are used, to water your ornamentals. Do not use on food crops.

23. Save rain water. Whatever happened to rain barrels? It makes sense to save winter's rain for summer's drought.

24. Limit lawn watering. Most lawn grasses require excessive watering to remain "attractive" during dry summers. If you are going to have a lawn, either enjoy the natural summer dormancy period nature employs to ensure survival or limit your watering to deficit levels. According to Dr. Stan Brauen of Washington State University (WSU), Puyallup, deficit irrigation is the concept of watering turf with a small percentage less than the plant would use under optimum conditions. Light, frequent irrigations of turf also will require less total usage of water in getting a lawn through a short (3-4 week) period of drought. However, this may weaken grass and make it more susceptible to cold damage in a cooler-than-normal winter.

25. Better yet, limit your lawn area. Replace most, if not all, of your lawn area with some of the many hardy, durable, and attractive ground covers for sun or shade. Many choices are available and include the more common disease-resistant junipers, or creeping thyme, or many exciting, new choices. The entry court garden at the Center for Urban Horticulture currently displays many interesting options. Most require less water and maintenance than lawn grasses, once they are established.

26. Mow correctly, at the right height. Don't scalp your lawn. Fine fescues and perennial ryegrasses can be mowed at 1¼", according to Gwen Stahnke, turf grass specialist at WSU. Mow often enough that you never remove more than one-third of the leaf surface at one time. Well-sharpened manual reel-type mowers make clean cuts—and human-powered machines do not release fumes from burning gasoline.

27. Plant a tree. A mature tree can annually recycle as much as 50 pounds of carbon dioxide, one of the contributors to the greenhouse effect. Trees can absorb CO_2 and prevent up to 90% of the nitrates that leach from fertilized cropland entering neighboring waterways. USDA officials estimate that the area of trees being lost just from the Amazon basin each year is equivalent to the size of the state of Illinois, so worldwide replacements are needed.

28. Select air pollution-tolerant plants. Use landscape materials that better endure pollution stress and therefore survive to contribute to reducing air pollution. Possible selections include species of *Abies*, *Camellia*, *Davidia*, *Hebe*, *Hydrangea*, *Laburnum*, *Magnolia*, *Malus*, *Morus*, *Philadelphus*, *Prunus*, *Pyracantha*, *Rhododendron*, *Ribes*, and *Rosa*

29. Grow house plants. Recent NASA research has demonstrated that certain house plants have the potential for improving air quality in energy-efficient buildings. Those cited included species of *Aglaonema*, *Aloe*, *Dracaena*, *Ficus*, *Hedera*, *Philodendron*, *Sansevieria*, and *Spathiphyllum*.

30. Use energy efficient designs. Place deciduous trees so they provide summer shade to cool your house, and allow for winter sun—when available—to warm it up. Correctly placed plants are effective as wind breaks.

31. Learn how and when to prune properly. Then prune to maintain the health and function of the plants involved. Invest in a good manual or enroll in a pruning class.

32. Teach a child to garden. Pass on the skills, appreciation, and ethics of responsible home horticulture that will help maintain a healthy ecosystem.

33. Give a green gift. Encourage others to develop a more responsible environmental ethic by giving them a plant and complete information regarding its care, function, and ecological significance.

34. Adopt a plant. Is there a tree in your neighborhood that needs a level of care its owner can't provide? Offer to "adopt" it; see to its needs and ensure its survival.

35. Talk to your elected officials. Most Northwest communities either already have or are currently working to develop landscape, greenbelt, and wetland preservation ordinances. Tell your elected officials what level of horticultural "insurance" you want.

36. Use and enjoy your landscape. Recognize the therapeutic values of working with or being around plants. Human health and well-being are vital components of a thriving ecosystem.

These are but a few tips. Whether you have an extensive home landscape, a few containers on the balcony, or a potted plant on the windowsill, you can use some of the ecologically sensitive home horticultural skills every day.

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Golden Chinquapin, Native Tree of Distinction

by A.R. Kruckeberg

Broad-leaved evergreens are choice subjects for gardens and public places west of the Cascades. Witness the popularity of elegant evergreen oaks, the madrone, and arborescent camellias and rhododendrons, to name a few. Yet there are but two natives in Washington of this desirable evergreen life form—the madrone and the golden chinquapin, *Chrysolepis chrysophylla*.

Our native golden chinquapin displays an impressive growth form. Its narrowly conical, spire-like shape can get up to 60 feet in height, with usually a single dominant leader. The evergreen leaves, 2 to 4″ long, are narrow, tapering at each end, a bit like that other Northwest native, Oregon myrtle (*Umbellularia californica*) of southern Oregon and California. The chinquapin's prime foliage feature is its two-toned hue, dark green above and a soft golden beneath. Indeed, it is the "gold-plated" look of the lower leaf surfaces that catches the eye and evokes the tree's common name, *golden* chinquapin. The golden sheen is created by tiny scales densely plastering the lower surface of the leaf. It is the same kind of coating found in lepidote rhododendrons.

As with other members of the oak family (Fagaceae), golden chinquapin flowers are insignificant, taken singly. The tiny male flowerlets are closely set upon upright spikes pale yellow in color. The female flowerlets start out as inconspicuous emergences at the base of the male spike. Then, after pollination, they enlarge to form impressive, straw-colored prickly clusters called *burs*. Each female flower in fruit can bear a single large triangular seed.

The golden chinquapin is one of only two species in its genus, *Chrysolepis*. Both are restricted to the Pacific Coast. The other species, *C. sempervirens*, is a large evergreen shrub with similar foliage and

Chrysolepis chrysophylla. *Photo by Sigurd Olsen.*

The Bloedel Reserve's Golden Chinquapins

Richard A. Brown

The culture of golden chinquapins (*Chrysolepis chrysophylla*) at the Bloedel Reserve on Bainbridge Island is a story of mixed success.

Apparently, in the early 1970s Mr. Prentice Bloedel acquired several good-sized specimens (3-5′) which he had planted west of the entry driveway. From the mid through the late 1970s, we began to experience losses of these first specimens. Plant decline typically was characterized by a one- to two-year period of declining vigor in which the leaves appeared to be smaller than those of the previous years and off color. Death of the specimen usually was preceded by a heavy fruit crop. Using seed gathered from these declining trees, we were successful at increasing the number of specimens on the estate. Of the original six to ten trees acquired, only four to five remain today. However, from the seedlings, we have at least 10-12 specimens, growing well; they range from five to eight feet tall.

At one time in the late 1970s, a fungal problem affecting the trees was eliminated by an application of a general purpose fungicide (Benomyl). The fungus was characterized by the appearance of irregular-shaped black blotches on the leaves. I have seen a similar fungus attacking fool's huckleberry (*Menziesia ferruginea*) in the wild.

We suspected that our early plant losses were a reflection of shallow soil conditions or high hardpan soil that the tree roots could not penetrate. The new trees were planted in an open field, sloping gently downward to the east. For only a few years after planting the trees were watered during the summer months.

Now we can count on good crops of fertile seed annually. Based upon our experience, these seeds will germinate readily if cold stratified in damp sand for 60 to 90 days. Chinquapins appear to be well suited to our mild climate and require little care after establishment, when ample sun and drainage are provided. They grow at a moderate rate, and in time should become attractive elements in the proper landscape setting. *Richard A. Brown is director of the Bloedel Reserve, a 150-acre estate featuring both natural and designed areas on Bainbridge Island, Washington.*

flower traits. *Chrysolepis chrysophylla* (formerly *Castanopsis chrysophylla*) ranges northward from the Sierra Nevada of California through the Cascade Range of Oregon, to southwestern Washington. It usually is found growing in mixed evergreen forests, especially in rather open stands of conifers. Although it is common south of the Columbia River in the western Cascades of Oregon, it is a genuine rarity in Washington. Its only known localities are near the Big Lava Beds of Skamania County and on the west side of Hood Canal (Mason County). It now is gone from its earliest known locality in Washington, at North Bonneville (Sudworth 1908). Its rarity in Washington State has put it on the Sensitive List of plants for Washington (Washington Natural Heritage Program 1990).

To see the golden chinquapin in the wild, I recommend the easier encounter along the lower western slopes of Mt. Hood in Oregon. It takes a bit of searching to find it in Washington. Even in its known localities, the populations are small, with only a few individuals. One cause of its rarity in Washington is ecogeographical: it is at the northern limit of its natural range. But the current rarity has been aggravated by indiscriminate logging, fungus disease, and collecting of specimens for cultivation. Fortunately, the United States Forest Service is attempting to protect the remaining colonies of stands in Washington. Despite this effort, recent logging in Skamania County destroyed several individuals. Even in cultivation, it has not always fared well; a fine specimen on the University of Washington campus was cut down several years ago to make way for a building site.

Golden chinquapin is not commonly found in private gardens or public collections. The best display of the tree is in the Wind River Arboretum, in southwestern Washington, managed by the

United States Forest Service. Here it is within its natural range and is even reproducing itself. (See Scot Medbury's article on Wind River Arboretum, "The Northwest Garden Explorer," *The Washington Park Arboretum Bulletin* 52(1): 12-13.)

Golden chinquapin seems to prefer a garden site with filtered sunlight, only partially shaded by other trees. It can be a stately tree under such conditions. A single specimen in an abandoned garden at Kitsap Lake, north of Bremerton, displays it elegance well. Similar specimens can be seen just northwest of Woodinville, where an old chestnut orchard that included chinquapins now has yielded to residential development. In full sun, the evergreen chinquapin tends to become an arborescent shrub. It will thrive with companion plantings of rhododendrons, evergreen oaks, and needle-leafed evergreens.

Do not expect to find golden chinquapin in most any nursery. But specialty nurseries and certain seed companies do offer them from time to time.

Arthur R. Kruckeberg is professor emeritus of botany at the University of Washington. He is a founder of the Washington Native Plant Society and consults about environmental impacts, plants, and vegetation. Dr. Kruckeberg and his wife Mareen run a nursery specializing in unusual shrubs and rock garden plants.

Nurseries Occasionally Listing Chinquapin:

Forest Farm, 990 Tetherow Road, Williams, OR 97544

MSK Nursery, 20066 -15th Avenue NW, Seattle, WA 98177 (grown sparingly from seed collected in Oregon or purchased from Callahan Seeds, 6045 Foley Lane, Central Point, Oregon 97502).

See listings in *Hortus Northwest*, a Pacific Northwest Native Plant Directory, PO Box 955, Canby, OR 97013

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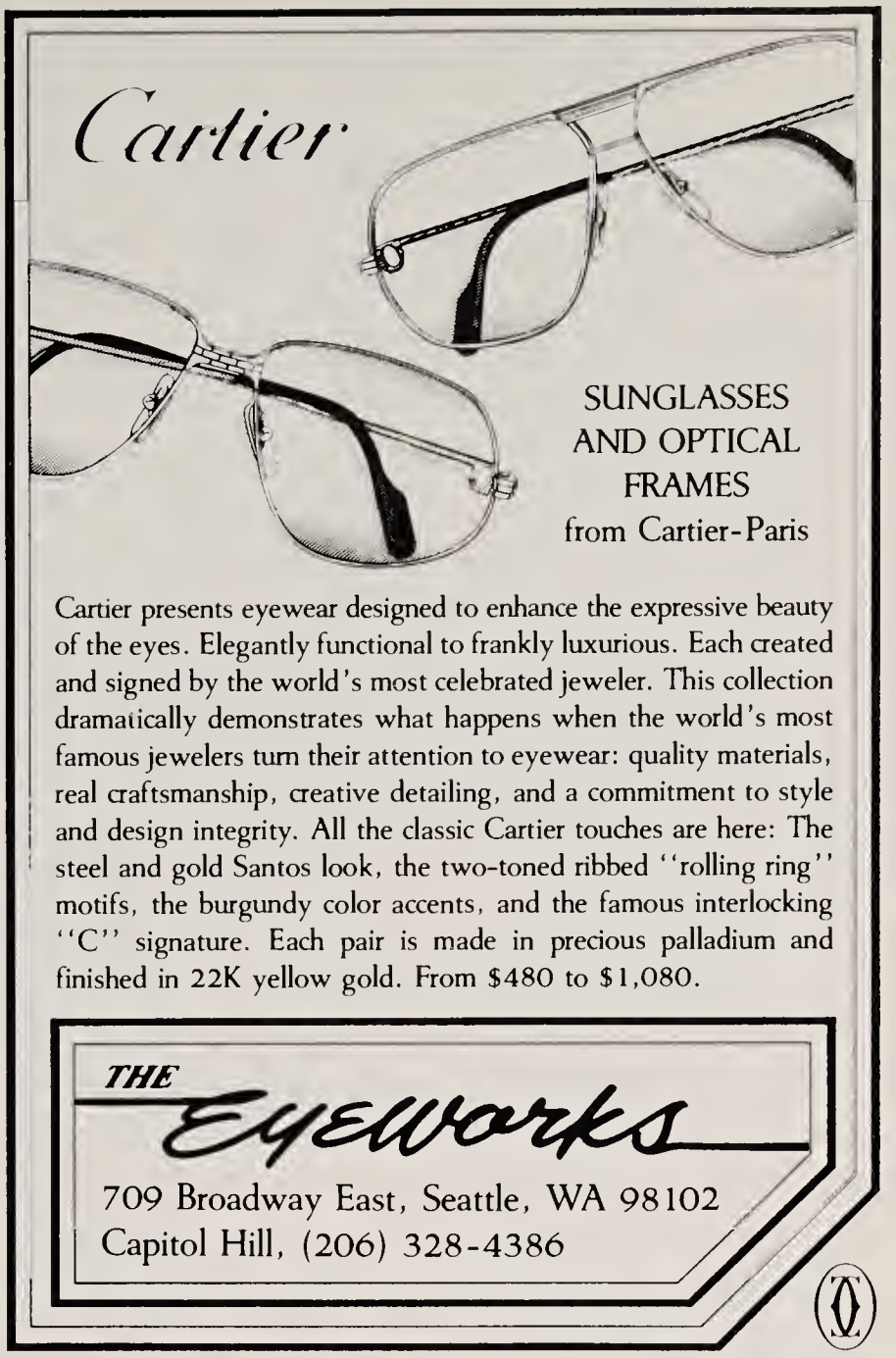

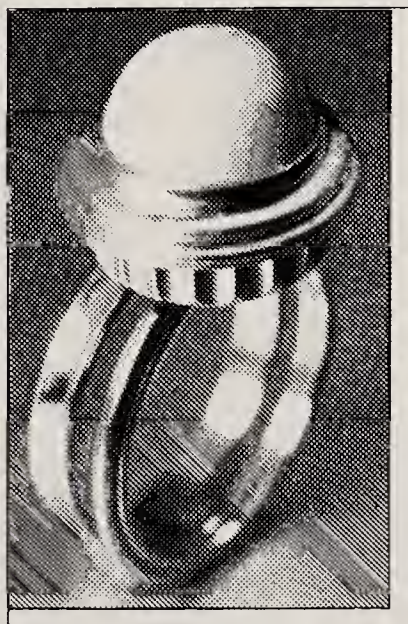

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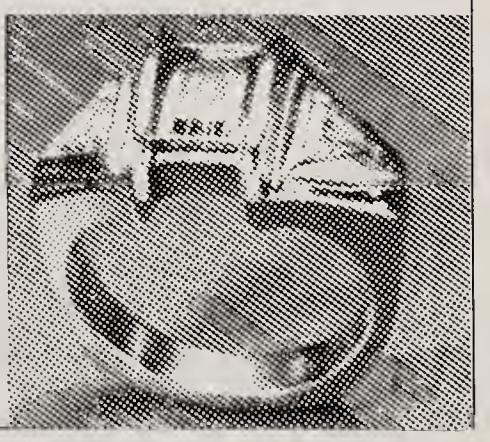

The Northwest Garden Explorer

Creating A Drought-Tolerant Herb Border

by Howard Stenn

Visit Seattle Tilth's herb border in Wallingford, a drought-tolerant, cold hardy garden.

Degree of difficulty:
Easy—wheelchair accessible.

Time: Daylight hours, all year long.

Best time of the year: Mid spring through mid summer.

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Buses: #26, #43.

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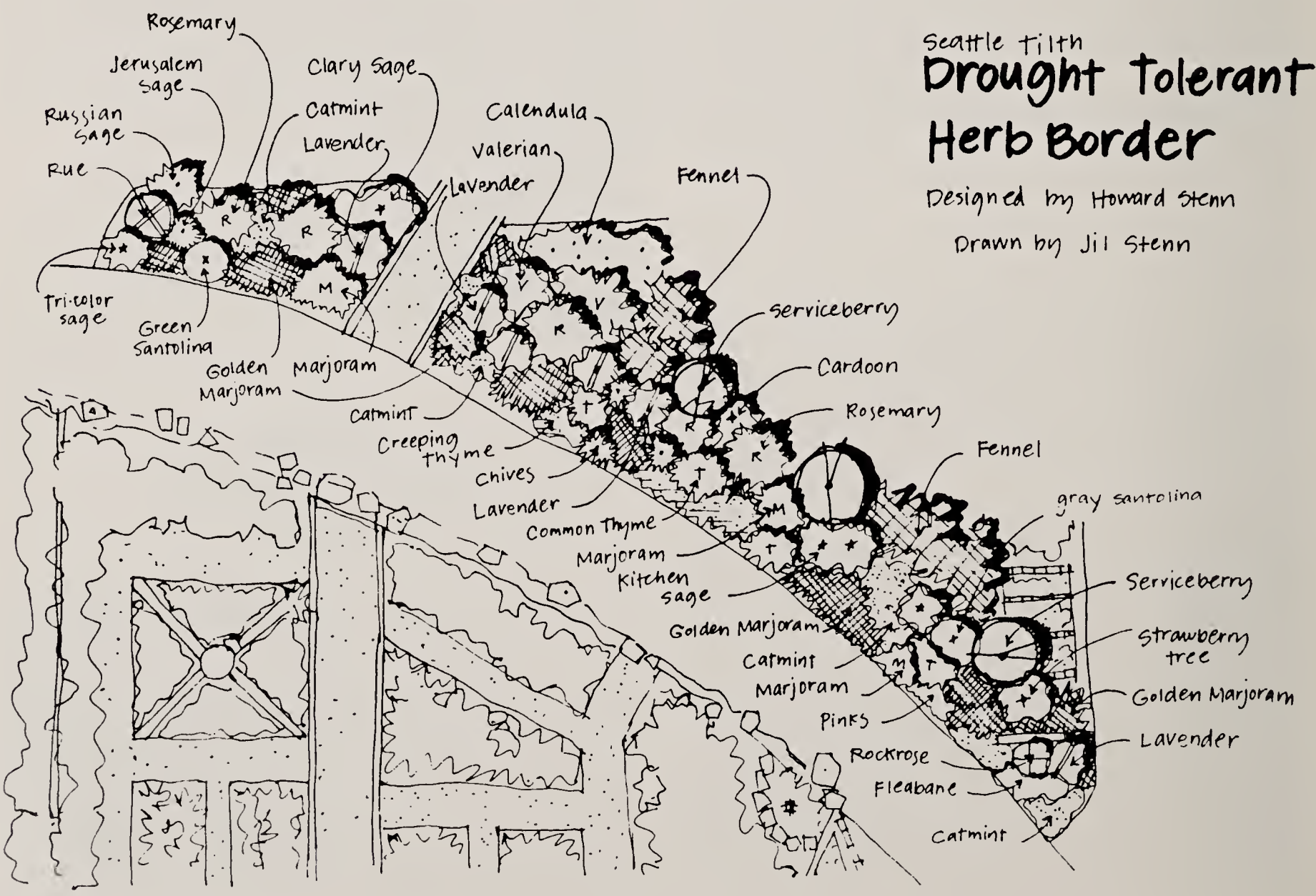
Southwest corner.

Rosemary. Lavender. Thyme. Marjoram. Most of us associate these flavorful herbs with the warm, dry climate of the Mediterranean and its rich cuisines. Yet you don't have to move to Italy to enjoy these herbs fresh in your kitchen. Many of the herbs from the Mediterranean region are quite hardy, and grow well in Pacific Northwest gardens.

Beyond their usefulness in our kitchens, many of these herbs are valuable landscape plants. They are beautiful, fragrant, and often evergreen; many produce delightful flowers and foliage that can be cut for arrangements. Perhaps best of all, their tolerance for infertile soils and drought makes them excellent low-maintenance garden plants. Their native habitat often is poor, rocky soils in a climate in which summer rain can be scarce. Once established, these herbs easily can stand up to the driest summers in the Pacific Northwest without any watering.

Since 1986, a border at the Seattle Tilth gardens in Seattle's Wallingford neighborhood has served as a laboratory for testing the hardiness, drought tolerance, and garden value of a wide variety of herbs from the Mediterranean and other regions, as well as flowering perennials and self-sowing annuals. The border was planted in the winter of 1985-86. It was irrigated twice during the first



summer, and since then only new summer plantings have been watered individually. Recent additions to the border have been planted in winter and never irrigated.

The first true test of the plants came in summer 1988, the driest in decades. Then came the hard winter of 1988-89, when low temperatures, ranging from 5 to 10°F, tested the already drought-stressed plants. With few exceptions (*Salvia elegans*, *Salvia leucantha*, and *Teucrium fruticans*), the border survived nearly intact. Since then, additions have been made using the proven drought- and cold-hardy plants.

The border is at its finest from early spring, when new foliage emerges, through mid summer, when flowering peaks. In late summer, the spent, dry flowers give a wild look, and are best sheared back in the autumn. The following is a list of some of the more useful plants that have passed the tests of drought tolerance, cold hardiness, and visual appeal. Each listing includes some notes on the plant's place in an ornamental garden and its uses in the kitchen and home. All of these plants should perform well in a sunny spot in your maritime Northwest garden (Sunset zones 4 and 5; USDA zone 8).

Rosemary (*Rosmarinus officinalis*) provides a sturdy, evergreen backbone of the border. Slow growing at first, it can reach 6′ tall and wide. Once established, rosemary produces periwinkle blue flowers and generous growth that can be cut and used for cooking meats and vegetables, in a variety of bath preparations, or just to make the house smell nice. Rosemary responds well to shearing. Prostrate forms are not reliably hardy.

The ''evergray'' foliage of **lavender** (*Lavandula angustifolia*) makes a nice complement in front of the dark green rosemary. Together, these form the foundation of the border. The cultivar 'Munstead' yields abundant fragrant flowers from May to October. French lavender (*L. dentata*) has very fragrant dark green leaves and dies back to a crown each winter to re-sprout in spring. Yellow-flowered lavender (*L. viridis*), which actually has white flowers, is citrus scented and hardy to at least 17°F. Dwarf forms (*L. angustifolia* 'Nana') are commonly used as walk edgings.

Green santolina (*Santolina rosmarinifolia*) and **gray santolina** (*S. chamaecyparissus*) are two more of the evergreen ''backbone'' shrubs in the border, providing structure year-round. Their attractive, feathery foliage sometimes is sheared to produce the ''weave'' effect in knot gardens. Unsheared, they grow to 2′ tall and tend to sprawl and flop over. Santolina (also known as lavender cotton) fits in well in the front and middle of borders. The dried foliage and flowers of santolina make a fragrant addition to bouquets, and are reportedly an effective moth repellent.

The old standby **kitchen sage** (*Salvia officinalis*) is as useful in the ornamental garden as it is on the stove. From May to October it produces abundant spikes of white and purple-tinged flowers which are long lasting when cut. Fresh sage leaves can be picked for cooking year-round. A red-leafed variety (cv. 'Purpurea') and one with red, yellow, and green leaves (cv. 'Tricolor') also grow well here.

The large, hairy gray leaves of **Jerusalem sage** (*Phlomis fruticosa*) attract attention year around, making it an excellent accent in the border. Whorls of bright yellow flowers make this plant even more attractive in early summer, and they also have very sweet nectar which may be sucked out of the plucked flowers for a garden snack. This slow grower has only reached 2′ high after 4 years here in Seattle, though specimens 4′ tall and wide are common in California.

During spring and summer, the 3 to 4′ tall flower spikes of **clary sage** (*Salvia sclarea*) shoot up from the back of the border, stopping passersby with their strong citrus aroma. The hairy gray-green foliage is attractive throughout the year if the old flower stalks are cut back in autumn. As a cut flower, clary sage also doubles as an air freshener.

Despite its name, **rue** (*Ruta graveolens* 'Jackman's Blue') is a beautiful shrub to 2′ high, with blue-gray foliage that fills in nicely around rocks or other shrubs. The sap of rue causes a rash on some people, so be careful when handling it.

Dominating the front of the border, low-growing **wild marjoram** and **golden marjoram**—which actually are forms of oregano (*Origanum vulgare*)—make a vibrant, spreading mat around larger shrubby herbs. The green and gold foliages of these two plants are lovely as they grow together and intertwine, and both are used to flavor Italian and Mexican dishes. These plants look best if the flowers are sheared back in fall to reveal a low mat of fresh, leafy growth through the winter.

Another low-spreading herb is **lambs ears** (*Stachys lanata*), which makes an attractive edging along walks and steps. The soft, fuzzy gray leaves are aptly named. They are used as a natural bandage that effectively stops bleeding from minor cuts. The one-foot tall fuzzy spikes of purple flowers are in-

itially pretty, but persist in a shaggy faded state if not cut back. A flowerless variety is also available.

Many varieties of low-growing **thyme** make attractive, edible edgings in front of larger shrubs and along walks. The flavorful common thyme (*Thymus vulgaris*) is a shrubby form which has many cultivars, including the silver-leafed 'Argenteus' and gold-leafed 'Aureus'. These thymes tend to get woody and sprawl in an ungainly way, and cutting them back does not always help their appearance. The creeping varieties of thyme are not as flavorful, but make beautiful mats which spread by root runners to fill in around rocks or plants. Creeping woolly thyme (*T. pseudolanuginosus*) is a resilient ground cover with gray, hairy leaves. Another attractive creeping thyme (*T. serpyllum*) has green foliage and is sold as "white thyme" or "mauve thyme," according to the color of its flowers.

The striking gray foliage and electric blue flowers of low-growing **catmint** (*Nepeta mussinii*) make it a standout in front of other plantings. Though less attractive to cats then catnip, a close relative, its mint-flavored leaves will bring the cats around and they may destroy newly transplanted specimens. Cats don't seem to bother directly sown seedlings.

We think of another Mediterranean herb as our own since it is so prolific here. **Calendula's** (*Calendula officinalis*) brilliant yellow and orange flowers can be seen all year around most years; they are such prolific self sowers that they will bloom in early spring, even after a hard winter. Also known as "poor man's saffron," calendula petals add color and flavor to salads, soups, rice, and other grains.

To this foundation of Mediterranean herbs is added a variety of drought-tolerant herbs and flowers of other origins. Some of the perennial herbs included are **green fennel** and **bronze fennel** (*Foeniculum vulgare* 'Rubrum'), which tower in the border background all summer long. The leaves of fennel provide a massive, yet wispy-textured, backdrop to the border from early spring to mid-summer, and make a wonderful addition to salads all through the year. In mid-summer, the flowers are cut for arrangements, and later the seeds are used as a spice. It is wise to remove the flowers or seeds to control fennel's rampant self-seeding.

Valerian (*Valeriana officinalis*) is another tall herbaceous perennial used in the rear of the border. Although valerian possesses medicinal properties, it is grown here for its beautiful, fragrant blooms in early summer. Another medicinal herb included is

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Echinacea (usually *Echinacea purpurea* or *E. angustifolia*). Also known as purple cone-flower, it is grown commercially for its roots, which produce an effective antibiotic. In the border, echinacea is valued for its beautiful purple or white petaled flowers with iridescent, spiky centers.

The common **chive** (*Allium schoenoprasum*) is an edible herb that may have medicinal properties on a level with chicken soup. Rich in vitamins A and C, the leaves and flowers of chives add a delicate onion flavor to soups, salads, and egg dishes. Chive flowers are also beautiful in arrangements.

The herbs described here exemplify the available choices that can be used to create the foundation of an attractive and productive drought-tolerant garden. They will add spice to your gardening and dining, with a minimum of effort—the ideal for gardening gourmets.

Howard Stenn is co-president of Seattle Tilth and has developed Tilth's drought-tolerant herb border. Mr. Stenn also is a partner in Environmental Axis, a landscape design and consulting firm specializing in resource-conserving gardens and plants.

In the Washington Park Arboretum

by Christina Pfeiffer and Timothy Hohn

By the June 13, 1990, dedication of the Brian O. Mulligan Sorbus collection, the majority of planting and site work had been completed. This fall, the staff has continued with follow-up on fine grading and seeding of turf areas, laying gravel for the trail, and seeding grass over the trail surface. Companion plants will be added to some of the bed areas, including a selection of groundcover roses.

The changes in this area have created a very pleasing open space in which to stroll among a broad display of *Sorbus* trees, which put on a spectacular display of brilliant berries and autumn color. You won't want to miss the equally spectacular display of blooms in the spring.

See the Woodland Garden's Katsura

The Woodland Garden is one of the fine focal areas of the Arboretum grounds, with its extensive collection of Japanese maples, variety of woodland plants, two ponds, and stream-side perennial beds. Over the past few years, we have continued to make improvements in this garden area.

In late September 1990, a very fine specimen of weeping katsura, *Cercidiphyllum magnificum* 'Pendulum' (accession 34-87), was planted on the north shore of the upper pond. This work was done with volunteer assistance from PlantAmnesty—a non-profit organization to promote public education on tree-care issues—during a planting demonstration it held here. The tree is finely displayed against the dark green backdrop of a nearby western redcedar.

Thanks to support from Arboretum Foundation Unit I-75, a bench has been placed near the upper woodland pond. It provides a pleasant view of both the pond and the newly planted weeping katsura.

The Roman Rhododendron Memorial Planting

A 1,000-square-foot planting of rhododendron hybrids is replacing a bland section of the planting bed on the east side of Azalea Way, just north of the Loderi Valley trail, thanks to a special gift from the family of the late Herschel Roman. The theme of this educational display is hybridization. Dr. Roman was the founder of the genetics department at the University of Washington, and had a great interest in rhododendron hybrids.

The planting will feature *Rhododendron* 'Lem's Cameo'—the parent of many modern hybrids—and those *Rhododendrons* that make up its genetic background. *Rhododendron* 'Lem's Cameo' is a very popular plant, with flower trusses in hues of orange and pink. This memorial bed is appropriately placed near the Memorial Garden of American Rhododendron Hybrids, which is partially funded by memorial donations through The Arboretum Foundation.

More Noteworthy Accessions: Summer 1990

The first three digits of the following numbers indicate the accession number; the second two digits are the year of accession.

465-90 *Quercus porphyrogenita* (Fagaceae family): a showy Mexican evergreen shrubby oak from cuttings of Arboretum accession 157-83.

500-90 *Paxistima myrsinites* form (Celastraceae family): an unusual (very elongated) foliage form; cuttings collected from the Bridge Creek section of the Pacific Crest trail in the North Cascade Mountain range by Timothy Hohn.

507-90 *Hakea lissosperma* (Proteaceae family): a showy member of the Proteaceae; wild-collected seed sent by the Melbourne Botanic Gardens, Victoria, Australia.

521-90 *Sorbus insignis* (Rosaceae family): Seed of this beautiful Himalayan mountain ash was received from the National Botanical Garden, Glasnevin, Dublin, Ireland.

Christina Pfeiffer is the horticulturist for the Washington Park Arboretum.

Timothy Hohn is the curator of living collections, Center for Urban Horticulture/Washington Park Arboretum.

Northwest Hort Review

by Van M. Bobbitt

Integrated Pest Management for Residential Landscapes

Integrated pest management (IPM) probably can allow us to reduce pesticide use in landscapes by 50 to 90%. And that is without sacrificing the appearance of our plants (Koehler 1985).

IPM differs from traditional chemical pest control in that (1) it depends on frequent monitoring of plants and pests so that control strategies are used only when and where needed; and (2) a variety of pest control strategies—cultural, mechanical, biological, and chemical—may be employed.

IPM has been quite successful in agriculture. For example, California almond growers were able to reduce their use of insecticides by 45% after adopting IPM practices. IPM allowed brussels-sprout growers to use only one aphid control spray instead of the seven originally needed per crop (Farrell 1990).

The development of IPM approaches in landscape horticulture has been slower, in part because the landscape ecosystem is more complex. One agricultural crop may cover hundreds of acres (e.g., wheat in eastern Washington), but hundreds of plant species might be planted in one residential block. Although a farmer may be concerned with managing only one crop species, the home gardener must become familiar with many plant species, their cultural requirements, and all their pest problems.

However, considerable progress has been made in landscape IPM during the past decade. The University of Maryland conducted a study in 1982 to compare the effectiveness of a traditional cover spray program to that provided by IPM in controlling landscape pest problems. A tree-care company provided 26 residential clients for the study. Previously, these landscapes received three cover sprays per year with an insecticide-miticide combination spray. The IPM program was based, instead, on monitoring followed by spot treatments. Monitoring consisted of inspecting the plants for problems every two weeks from mid-April to early September. When significant pest problems did develop, spot treatments were made only to those plants with pest problems.

Information obtained from monitoring ensured that when pesticides were used, they were used at times to be most effective in controlling the pest. Thanks to better timing, the spot sprays were more effective than cover sprays, and pesticide use was reduced by 94%, according to Holmes and Davidson (1984).

As previously mentioned, landscapes have a greater diversity of plant species than agricultural lands. But University of Maryland researchers found that a relatively few genera account for the bulk of all the plants found in the landscape. For example, in this study azaleas comprised 20% of the total plants monitored. The 10 most common plants accounted for 60% of the total, and the 20 most common made up 70% of the total. Therefore, if you can identify the 20 most common landscape plants in your garden, know their cultural requirements, and recognize key pests, you can deal with most of the landscape problems you will encounter.

The job is further simplified because among those common plants, only some are problem prone. In the mid-Atlantic states, *Malus*, *Pyracantha*, *Cornus*, *Prunus*, and *Rosa* were problem prone, whereas *Viburnum*, *Taxus*, and *Forsythia* generally were free of problems.

The problem-prone plants are called "key plants," and they will require the most attention. The key plants will vary from one region to another. A key plant in western Washington might be Pacific dogwood (*Cornus nuttallii*) because the species is severely affected by dogwood anthracnose disease.

In addition to key plants, there are "key pests." These are the small number of serious, perennial pests that dominate pest control practices. On the University of Maryland campus, 10 key pests accounted for 95% of all the insect and mite problems encountered in the landscape (Raupp, et al. 1985).

Another basic concept of IPM is the emphasis on promoting plant health. The Davey Tree Expert Company started an IPM service in 1987 which they called *Plant Health Care*. Plant Health Care was described as "a comprehensive approach to improving tree health through proper selection, planting, and care. Since the concept of Plant Health Care emphasizes preventative maintenance,

the health of the tree (not pest control) is the central focus of our service'' (Funk 1988).

We have seen that IPM can be successful in landscape situations. Home gardeners can implement IPM through the following steps:

1. *Know your plants*. Become familiar with the cultural requirements and pests of your landscape plants. Pay special attention to key plants.

2. *Know your pests*. What are the key pests in your garden? When are these pests most vulnerable to control measures?

3. *Monitor*. All IPM programs depend on frequent inspection of plants for pest problems. Also, observe other factors in the landscape ecosystem. Weather, wildlife, pets, and human activity can affect plant health.

4. *Optimize plant health*. With the information gathered in steps one to three, you can minimize pest problems through proper plant selection and cultural practices. Remember, the primary goal is plant health.

5. *Consider several control strategies*. Pest control strategies include cultural, physical/mechanical, biological, and chemical approaches.

Pest control strategies should effectively control the pest while having minimal side effects on the rest of the environment.

An example of such control strategies for root weevil, a key pest of rhododendrons in the Puget Sound region, can be found in Washington State University (WSU) Extension Bulletin 0970, ''Root Weevil Control on Rhododendrons,'' available through the Washington State University Cooperative Extension office in your county for 75¢.

Root Weevil Control

1. *Cultural*: ''Recent research by WSU entomologists has shown some species and hybrid rhododendrons to be less susceptible to adult weevil feeding than others.'' (A list of species and cultivars that show resistance is included in the bulletin.)

2. *Mechanical*: ''Bands of sticky material, such as Tanglefoot, Stik-Em, and Tack Trap, applied to the trunk of the shrub, will keep weevils down.''

3. *Biological*: ''There is currently an organism (nematode) called *Neoplectana carpocapsae* available for control of immature root weevils as a soil drench.''

4. *Chemical*: ''Apply Orthene, according to label instructions, to foliage when first signs of notching on new leaves are noticed. . . . Bendiocarb is also registered for adult weevil control in ornamentals as a 1% dust. See label for use directions.''

Another valid IPM strategy is *no* action if it is determined that a certain level of pest damage can be tolerated. Since rhododendrons usually can tolerate weevil damage, the decision on whether to employ control measures or not is based on aesthetics. If a rhododendron is located near the entrance to a house where the foliage will be viewed up close, control measures may be more critical, but if a plant is viewed only from a distance, the root-weevil chewed leaves will not be noticed anyway.

Van M. Bobbitt is the Master Gardener/Urban Horticulture Coordinator, Washington State University Cooperative Extension.

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Book Reviews

The Vanishing Garden: A Conservation Guide to Garden Plants. Christopher Brickell and Fay Sharman. Timber Press, Portland. 1986. ISBN 0-88192-030-4 $24.95.

Christopher Brickell is one of England's most eminent horticulturists. He was director of Wisley Gardens for many years, and now is director-general of the Royal Horticultural Society. His encyclopedic knowledge of plants is evident throughout this book. Brickell is active in the British National Council for the Conservation of Plants and Gardens (NCCPG) and is well qualified to discuss the nearly 100 herbaceous plants, alpines, shrubs, trees, and greenhouse plants covered in this work. Some of these are old garden favorites such as *Dianthus*, campanulas, cosmos, roses, and the like, whereas a number are exotics that Brickell believes should be introduced as valuable additions to the garden. Too often, new introductions become avidly sought after to the detriment of the old, reliable favorites.

The reasons for preserving and growing each plant are given, and the origin and history of each introduction to British gardens is provided with interesting anecdotes. Sea captains, pirates, missionaries, and plant explorers all had a hand in bringing back new and exotic plants to England, where they were eagerly awaited. Hybridization, which began in Queen Victoria's reign, soon produced an overwhelming number of new varieties. As a result, many of the forebears were relegated to obscurity. Brickell goes into such depth with each plant, that with few exceptions I wondered if I had learned more than I really wanted to know.

In recent years, the loss of plants in the wild has increased rapidly. A number of fine garden plants now owe their existence to cultivation, as they are no longer found in the wild. Brickell points out that wild and cultivated plants are of vital importance to scientific research. Due to economic circumstances, nurseries have had to streamline their production. Understandably, says Brickell, they cannot afford to propagate difficult plants that may not prove profitable in the marketplace.

Although this is a British book, its message applies equally to plants on the North American continent. A major objective of the NCCPG, begun in 1978, has been to form a network of national collections. Each collection is devoted to a single plant,

Ginko biloba,
from The Vanishing Garden

and every known variety of that genus is contained in that particular plant collection. These collections are centered in botanical gardens, nurseries, schools, private gardens, and National Trust gardens and serve as living museums of plants and a source of material for breeding, propagation, and research. They range from the national *Dianthus* collection and the *Geranium* collection, to the rose collection and the *Viola* collection. North America could well do with an undertaking such as this to save the many plants endemic to us that are quickly disappearing.—*Reviewed by Virginia Morell*

Virginia Morell is past president of the Holly Society of America, a long-time member of The Arboretum Foundation, and a member of the editorial board of the *Washington Park Arboretum Bulletin*.

The Ecology of Urban Habitats. O.L. Gilbert. Chapman and Hall, London. 1989. 369 pages. ISBN 0-412-28270-4 $77.50.

The view that the maintenance of civilization should include a battle against nature still has many adherents.

"This is the first sentence of Gilbert's book, and throughout the text, he takes the position that a benign neglect of many urban areas makes them much more functional as plant and animal habitats. He points out that the "technological landscape" supports a different cast of characters than does the natural landscape. The book is unusual in that weedy, introduced, urbanized species (e.g., Oxford ragwort, Japanese knotweed, alien grains around breweries, horse-radish, feral pigeons, house sparrows) often are the subjects, and the relationships between these organisms and their environment is detailed. In addition, the author advocates the value of such urban biota. He outlines specific and sometimes unusual ecological relationships by chapter for vacant lots and abandoned

building sites, industrial areas, railways, roads, city centers, parks, subdivisions, cemeteries, lawns and gardens, and lakes and rivers.

The book is relevant to urban dwellers who want to know more about natural systems as modified by humans. Although written for the United Kingdom using British terms and discussing British species, the application of ecological principles to the townscape is fascinating (e.g, the relationship between stages of the construction of a building and stages of plant succession). It certainly made me want to go out and look for North American analogs. The intended audience is general/scientists, as this is actually an ecological textbook. The goal of the author seems to be not only to show that urban ecology is an interesting topic, but to make the reader interested in it.—*Reviewed by Kern Ewing*

Kern Ewing is assistant professor of Urban Ecology, Center for Urban Horticulture (CUH), University of Washington. He was research assistant professor, Center for Wetland Resources, at Louisiana State University, and has had related posts. Formerly the director of environmental planning for the Texas General Land Office, Ewing has been at CUH since summer 1990.

For Further Information

by Valerie Easton

Water Conservation

A continuing theme in this issue is water in a variety of its aspects: water quality, water-saving strategies, and drought-tolerant plants and gardens. We in the Northwest have been blessed with such an abundance of water that our rivers, lakes, salt water, and precipitation have long been taken for granted. Our increasing awareness of water use and quality, and of our own Mediterranean-type summer climate (summer of 1990 is a fine example) has caused Northwest gardeners to seek information on water conservation.

Information on how to best conserve this limited and valuable resource has been more plentiful in the last few years. Some of the best books and information sources are listed below.

There are several ways to approach the idea of gardening with less water usage. A title that addresses the issue as a whole is ***Water Conservation in Landscape Design and Management*** (Gary O. Robinette, New York: Van Nostrand Reinhold, 1984). The first section of the book discusses the impact of water on human life and activity, and what has been done in the past, nationwide, to deal with drought and water quality. The last half of the book gives practical information on developing unthirsty landscapes, mulching, erecting wind barriers, and other strategies.

Water-saving tactics are explored in *Sunset's* new ***Waterwise Gardening*** (Lane Publishing Co., 1989). Especially valuable are the sections on the water efficient lawn, working with soil as a first step in water conservation, and a section entitled, ''If You're Not Ready to Start Over,'' which encourages the home gardener to renovate existing landscapes by stages to reduce water dependency.

Successful Gardening with Limited Water by Margaret T. Wheatly (Santa Barbara: Woodbridge Press, 1978) is an older publication, but still valuable for its comprehensive and enthusiastic approach to dry gardens. Along with extensive plant lists there is a chapter on garden management that covers watering techniques, soil enrichment, weed control, and mulching, as well as plant selection. This book not only gives good, basic information on how to create a more maintenance-free, drought-tolerant garden, but makes it sound like a worthwhile—even exciting—way to garden.

A very enjoyable book written in the individualistic and knowledgeable British garden-writing tradition is ***The Dry Garden*** by Beth Chatto. Creating a large garden of many different kinds of plants in poor soil in the driest part of the British Isles has given Ms. Chatto much personal experience in dry gardening. The plants she recommends are from the plant communities of the Mediterranean, the California chaparral, Soviet Central Asia, and Afghanistan; all are hardy in an English winter. Descriptions of plants include recommendations for dry shade or dry sun, south-facing walls, and other dry garden areas. But most useful and interesting are Ms. Chatto's advice and observations, such as: ''Outstanding in the droughts were the grey and silver foliaged plants—these became whiter as the grass baked biscuit colour,'' and ''It sounds so obvious, but is worth stating I think, that I find it best to plant plenty of something that looks good most of the time rather than struggle to keep alive plants which at best only accentuate the fact that what you have to offer them is not what they need.''

Another approach to water conservation in the garden is to follow the above words of advice, and use the plants most appropriate to your growing conditions. ***Gardening with Native Plants of the Pacific Northwest*** by University of Washington professor Arthur R. Kruckeberg (Seattle: University of Washington Press, 1982) is the premier guide to garden and landscape uses of our native trees, shrubs, and herbaceous plants.

Other excellent guides to successful plant selection for a variety of growing conditions include ***Right Plant, Right Place*** by Nicola Ferguson (New York: Summit Books, 1984), ***Plants for Problem Places*** by Graham Rice (Portland: Timber Press, 1988), and ***Perfect Plant, Perfect Garden*** by Anne Scott-James (New York: Summit Books, 1988). Each of these books discusses dry gardens, problem soils, and hardiness factors in garden planning.

California, because of its many years of dealing with water shortages, is far ahead of the Northwest in collecting and distributing information on drought gardening. Two very useful California publications are ***Plants for California Landscapes: A Catalog of Drought Tolerant Plants*** (Department of Water Resources, State of California, Bulletin 209, Revised February 1981), and ***Success List of Water Conserving Plants*** (Saratoga Horticultural Foundation, June 1983). Each has extensive listings with brief descriptions (including hardiness information) on a wide variety of plants, and includes California natives as well as ornamentals.

Watering techniques have become much more efficient in recent years, with drip irrigation very effective for home gardeners. Instead of watering the ground, a drip system applies water slowly and steadily—directly to plant root zones. ***Drip System Watering for Bigger and Better Plants*** by Jack Kramer (New York: W.W. Norton & Co., 1980) is a thorough guide for the home gardener on how to set up a drip system for a variety of garden situations, including containers, raised beds, and mixed borders.

There are many resources available besides books; often they are low cost or free, and concise and local. ***Outdoor Water Conservation: Water Efficient Gardening*** is a five-page pamphlet full of basic practical advice, available free from the Seattle Water Department Conservation Office, (206) 684-5879). ***Drought Gardening***, by Sue Hakala, Garden Way Publishing Bulletin A-73, is an excellent, comprehensive 32-page pamphlet for the home gardener (Storey Communications, Schoolhouse Road, Pownal, Vermont 05261. Attn: Mail Order; $4.70, includes postage. The toll-free number for further information is 800-441-5700).

King County Cooperative Extension Service has audio tapes on water conservation topics, (206) 296-3425, or call (206) 296-3986 for publication KC-125 on low water-use plants.

A national organization dedicated to making gardens and plantings more water efficient is the National Xeriscape Council, Inc. Call or write for information at (515) 392-6225, PO Box 163172, Austin, Texas 78716-3172.

Journals can be the best source of current information. Articles on water concerns appear frequently in *National Xeriscape News*, *Pacific Horticulture*, *Organic Gardening*, *Horticulture*, *Sunset*, *American Nurseryman*, *Landscape Management*, and others. An extensive bibliography of both books and journal articles on gardening during drought is available in the Elisabeth C. Miller Library, Center for Urban Horticulture.

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Capon, Brian. **Botany for Gardeners: An Introduction and Guide**. Portland: Timber Press, 1990.

Clouston, Brian, editor. **Landscape Design with Plants**, 2nd edition. Boca Raton: CRC Press, 1989.

Flint, Mary Louise. **Pests of the Garden and Small Farm: A Grower's Guide to Using Less Pesticide**. Oakland: University of California Statewide Integrated Pest Management Project, Publication 3332, 1990.

Green, Michael. **Building for the Garden**. Port Melbourne, Australia: Lothian Publishing, 1989.

McHoy, Peter. **Outdoor Floors: The Design and Maintenance of Lawns, Patios, and Ground Covers**. Topsfield, Massachusetts: Salem House, 1989.

Miller, Everitt L., and Dr. Jay S. Cohen. **The American Garden Guidebook West**. New York: M. Evans & Co., 1989 (including over 30 listings of Northwest gardens).

National Science Resources Center. **Science for Children: Resources for Teachers**. Washington, D.C.: National Academy Press, 1988.

Wilson, Jim. **Landscaping with Container Plants**. Boston: Houghton Mifflin, 1990.

Woolman, Jack. **A Plantsman's Guide to Chrysanthemums**. London: Ward Lock, 1989.

Yang, Linda. **The City Gardener's Handbook: From Balcony to Backyard**. New York: Random House, 1990.

All of these books can be found in the Elisabeth C. Miller Library, Center for Urban Horticulture, University of Washington. The library is open 9 a.m. to 8 p.m. on Monday; 9 a.m. to 5 p.m., Tuesday to Friday.

Errata

In 53:3 of the *Washington Park Arboretum Bulletin*:

on page 5, *Quercus glacus* should be *Quercus glauca*.

on page 7, *Taxus olia* 'Stricta' should be *Taxus baccata* 'Stricta'.

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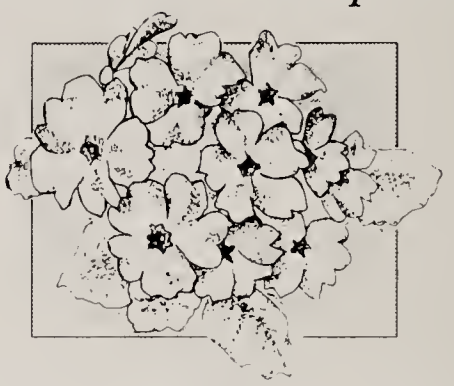

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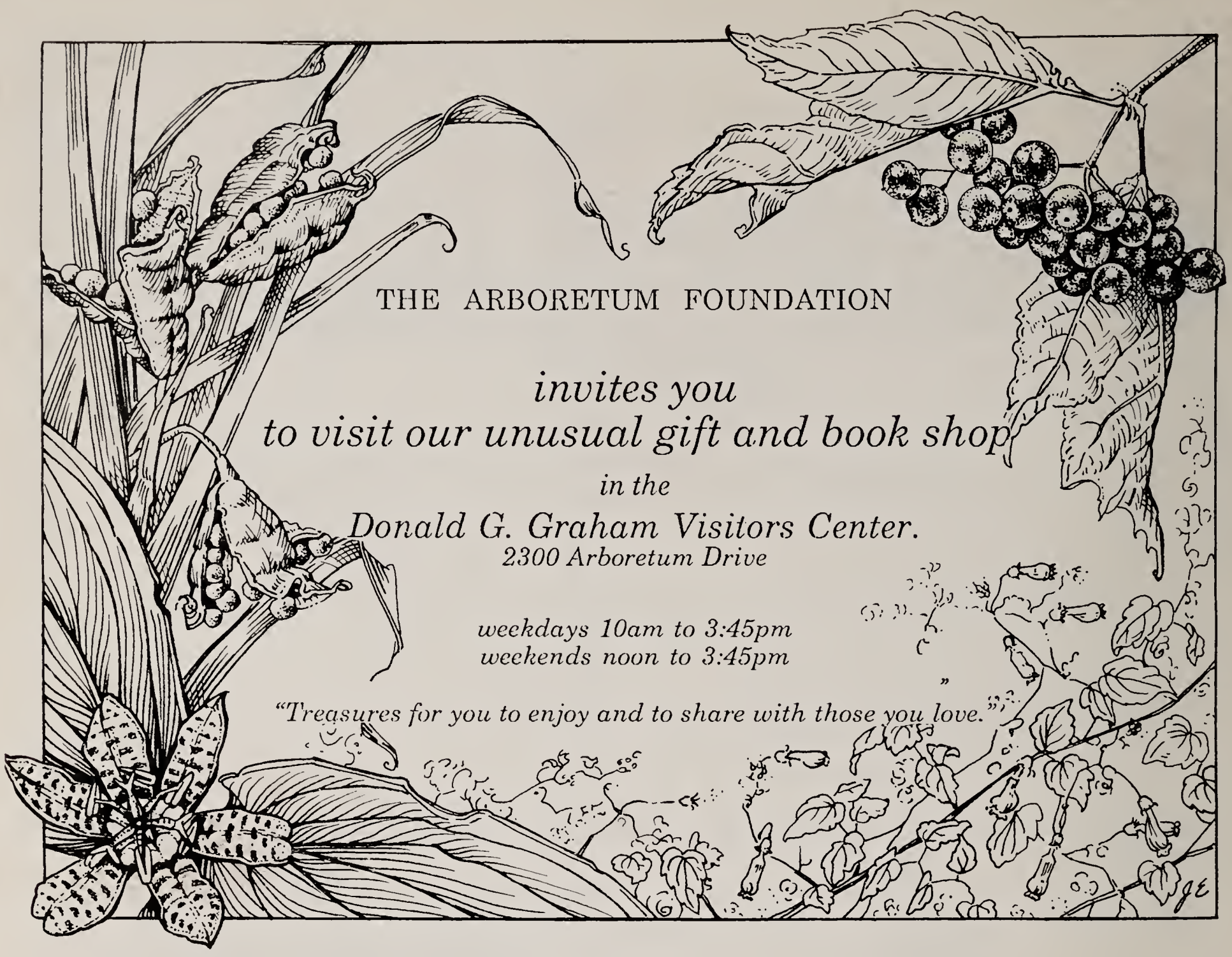

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